The Dynamic Synchronization Matrix: An Automated Decision Support Tool For The Campaign Planning Staff

A Monograph
by

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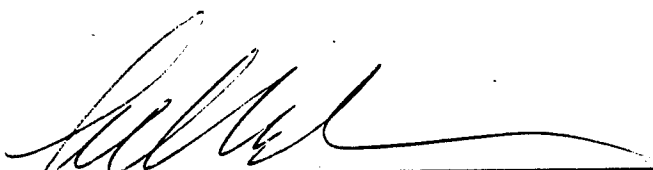
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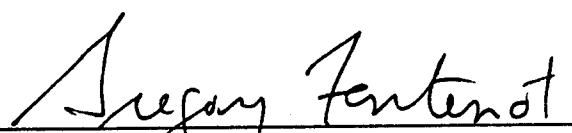
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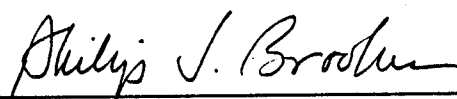
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ABSTRACT

THE DYNAMIC SYNCHRONIZATION MATRIX: AN AUTOMATED DECISION SUPPORT TOOL FOR THE CAMPAIGN PLANNING STAFF by MAJ Kevin S. Donohue, USA, 75 pages.

Synchronization, "the ability to focus resources and activities in time and space to produce maximum relative combat power at the decisive point," is a tenet of US Army doctrine. This monograph reviews the concept of synchronization at the operational level, and provides campaign staffs with a decision support tool in order to improve operational level planning and execution for the employment of joint US military forces.

Operational synchronization is more complex than simply massing "operational level" combat power at the "operationally" decisive point. Commanders and their staffs must be capable of conceptualizing, or "visualizing" across multiple forces and functions, and their actions and effects through space (or media) over extended periods of time.

This paper proposes an automated technique (labeled the "Dynamic Synchronization Matrix") for synchronizing forces at the operational level. The Dynamic Synchronization Matrix is a simple adaptation of a commercial project management program, run on a personal computer in a Windows environment, which improves upon existing capabilities because it combines the two distinct major improvements of PERT methodology and automation. This decision support tool improves upon the two-dimensional synchronization matrices that enable modern tactical planning and command and control by making connections between time, space, forces, functions, actions, and effects which the average human would have difficulty making and storing.

The net gains in employing the DSM include more disciplined planning, greater flexibility in subsequent planning and execution, multiple display options, greater speed, agility, and accuracy, enhanced situational awareness and information management, insights into one's own plan and enemy strengths and vulnerabilities, and linkage and applicability to subordinate echelons and other levels of war.

The Dynamic Synchronization Matrix represents a step forward in providing campaign staffs with the decision support tools they need in order to improve operational level planning and execution for the employment of joint US military forces.

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Section I: Introduction

Synchronization has been one of the stated principles of US Army doctrine since it first appeared as one of "AirLand Battle's" original four tenets in the 1982 version of FM 100-5, Operations.[1] The current version of this cornerstone doctrine defines synchronization as "the ability to focus resources and activities in time and space to produce maximum relative combat power at the decisive point."[2] This monograph has two purposes: to review the concept of operational synchronization, and to provide campaign staffs with a decision support tool in order to improve operational level planning and execution for the employment of joint US military forces.

This monograph will begin by exploring the concept of synchronization from a somewhat abstract and theoretical perspective. It will then proceed to focus on the unique challenges of synchronization at the operational level of war. After the theoretical underpinnings are established, this paper will propose an automated technique (labeled the "Dynamic Synchronization Matrix") for synchronizing forces at the operational level.

Several recent trends serve to make synchronization more difficult than ever before. First, the modern battlefield has steadily increased in complexity. According to General William E. Dupuy, today's commander deals with three times the complexity confronting Clausewitz, as war has expanded not only into the vertical dimension (as explicitly reinforced by the label "Airland Battle doctrine"), but also the realm of high-tech electronics.[3] Apart from sheer complexity, the phenomenon of time compression has been caused by technological improvements which enable military decisions and actions to occur more swiftly than ever before.[4]

The manual and automated planning systems that enable modern command and control have attempted to keep up with the increased physical and cognitive workload necessary to command and control forces.[5] While some automated systems offer partial solutions to

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operational synchronization, in practice, staffs are still using manual solutions.[6] According to a former director of the US Army's Command and Control Directorate, Combined Arms Developments Activity, "Computers have certainly made inroads [in C2], but for the most part, we have not determined how to use the computers to full capacity."[7]

Hence, in an important staff activity which is steadily increasing in complexity and more time-sensitive than ever before, staffs continue to synchronize forces with a stubby pencil, even at the highest echelons.[8] This is clearly an area where, whether for procurement, fiscal, or organizational reasons, we have failed to, in the words of Chief of Staff of the Army General Gordon Sullivan, "harness the microchip."[9]

This monograph asserts that a partial solution is readily available, found at the intersection of the traditional and emerging military disciplines of command and control, decision-making, operations research, and automation. The modest computer product presented in this monograph is only an interim and incomplete first step, provided more to show what it does, and to hint at what can be done in future efforts. I have labeled the product the "Dynamic Synchronization Matrix."[10]

The implication that a synchronization matrix can be dynamic deserves elaboration. Moltke the Elder's axiom that no plan survives contact with the enemy is not grounds for failing to plan carefully, nor is it reason to dismiss synchronization as the irreconcilable enemy of initiative, agility, or maneuver warfare. The solution is to devise a planning tool which can continuously adapt. As the US Marine Corps' FMFM 1-1, Campaigning suggests, detailed planning is "simply a common basis for change."[11]

Scope

In the interest of dissemination of ideas, this paper will utilize no information which would require a classification be placed on the product.

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In this monograph, not every pertinent aspect of the command and control, automation, and synchronization of operational level forces can be adequately addressed. For instance, this paper will emphasize the logic and discipline of dynamic synchronization, and avoid suggesting that the solution is only available with specific hardware or software. This severely limits any discussion of the vital issues of systems interoperability and connectivity.

This paper is not focused on the issues of logistics or deployment. This is a conscious attempt to reassert the importance of the employment of forces in a manner which achieves the strategic objective. In his classic, recently rediscovered book Strategy, the preeminent Soviet military instructor and author Aleksandr Andreevich Svechin criticized Moltke's belief that "the primary task of strategy is to prepare materiel and the first deployment of the armies."[12] To Svechin, "the mental center of gravity should not lie in occupying an initial position but in operations, if only on paper."[13]

Yet several experts in military planning have criticized that our military's OPLANs have become primarily deployment plans.[14] JOPES, the automated system designed to assist in campaign planning, has only accentuated this imbalance.[15] In practice, the phasing and sequencing inherent in campaign planning are becoming synonymous with deployment, or even the complex deployment spreadsheet known as the Time-Phased Force and Deployment Data (TPFDD).[16] This paper seeks only to reverse this trend, not to ignore sustainment and deployment. Perhaps a partial solution focused on employment is no better than a partial solution focused on deployment. Clausewitz, however, reminds us to consider the last step before taking the first.[17]

Synchronization Across the Levels of War

Warfare may be viewed through strategic, operational, and tactical levels of analysis. Synchronization is clearly important at the strategic level of war, as military activities at the

national and/or alliance level need to be in synchronization with other national instruments of power, such as informational power, economic power, and diplomatic power.[18]

At the tactical level, synchronization remains a heavily emphasized, yet commonly cited deficiency of our forces in training.[19] US Army lessons learned and after-action reports from various sources reveal that synchronization is often weak in the employment of our combat forces. It is often not done, or poorly done; the US Army's Center for Army Lessons Learned (CALL) documents led one researcher to conclude in 1990 that "the single major problem units are observed to have in using the command estimate is synchronization of the BOS [Battlefield Operating Systems]."[20]

Between the tactical and strategic level, it is now generally accepted in military theory and doctrine that the increasing complexity and scope of warfare has given birth to an intermediate level commonly known as the operational level of war (which, for the purposes of this paper, will be considered the primary province of campaign planning). While the US Army readily discusses and redresses deficiencies in synchronization at the tactical level, the area of operational level synchronization remains largely unexplored. This monograph is about the latter, a special form of synchronization whose uniqueness is only recently being examined.

The genesis of the operational level of war, and its relation to time and space, is often described as a rejection of, or at least an evolution from, the classical military "strategy of a single point," as represented by the writings of Clausewitz and Jomini, among others. To draw such a contrast is unfair, as Clausewitz was aware of the impact of increasing space and time on military operations. Although Clausewitz may have preferred the effectiveness of a single decisive battle, he recognized that

> . . . our wars today consist of a large number of engagements, great and small, simultaneous or consecutive, and this fragmentation of activity into so many

separate actions is the result of the great variety of situations out of which wars can nowadays arise.[21]

Clausewitz's solution was to emphasize campaigning, which he described as a series of linked military events occurring in a single theater of war, for "war does not consist of a single short blow," since a nation cannot deploy all its resources at once.[22]

The Prussian philosopher of war also demonstrated insight into operational synchronization when he explicitly addressed the issues of simultaneity in comparison to sequenced actions:

> ...all forces intended and available for a strategic purpose should be applied simultaneously; their employment will be the more effective the more everything can be concentrated in a single action at a single moment.
> That does not mean that successive efforts and sustained effects have no place in strategy. They cannot be ignored, the less so since they form one of the principal means toward a final success: the continuous deployment of new forces.[23]

Such passages clearly establish Clausewitz's recognition of an operational level of war in which victory is the light at the end of a long tunnel, and not the next battlefield away. A century later, the Soviet operational theorist Tuchachevsky similarly noted that

> The nature of modern weapons and modern battle is such that it is an impossible matter to destroy the enemy's manpower by one blow in a one day battle. Battle in a modern operation stretches out into a series of battles not only along the front but also in depth until that time when either the enemy has been struck by a final annihilating blow or when the offensive forces are exhausted.[24]

The modern operational level of war is probably more complex than these theorists envisioned. Such operations are almost always joint, and often combined, in nature. The current Joint Pub 1-02, DoD Dictionary of Military and Associated Terms, provides the following definition of the operational level of war:

> The level of war at which campaigns and major operations are planned, conducted, and sustained to accomplish strategic objectives within theaters or areas of operations. Activities at this level link tactics and strategy by establishing operational objectives needed to accomplish the strategic objectives, sequencing

events to achieve the operational objectives, initiating actions, and applying resources to bring about or sustain these events. These activities imply a broader dimension of time or space than do tactics; they ensure the logistic and administrative support of tactical forces, and provide the means by which tactical successes are exploited to achieve strategic objectives.[25]

Beyond the definitions of the operational *level* of war come the discussions of the conceptually related operational *art* of war. According to FM 100-5, operational art is "the skillful employment of military forces to attain strategic and/or operational objectives through the design, organization, integration, and conduct of campaigns, major operations, and battles."[26] This paper will explore how to make a commander and his or her staff "more skillful." Every possible aspect of war should be conceptualized in terms of understandable, if not controllable, processes. This is probably an unachievable goal, at least in the present, but that should not dissuade the professional military student from making progress. Effective quantification of relatively understandable dynamics leaves more of a commander's time available for the real genius of war, the essence of which might always remain an unassailable fortress in the province of art.

Section II: Synchronization: The Intersection of Time/Space/Force/Function

> Strategy is the art of making use of time and space. I am less chary of the latter than the former. Space we can recover, lost time never.
>
> -- Napoleon[27]

The Dynamic Synchronization Matrix borrows many concepts from the world of military theory and doctrine. Therefore, this chapter conducts a review and comparison of various concepts related to synchronization, concluding with a discussion of synchronization itself.

Time

Humans are bounded by time, a unidirectional and invariable measurement which advances at an objectively measurable, unchanging rate. A comprehension of time is a critical component of synchronization. Time-force analysis is certainly not unknown in the history of warfare; the 17th Century French engineer Vauban is reputed to have been able to calculate the number of days it would take a besieged fortress to fall.

Precise temporal predictions are less achievable in most forms of modern warfare. Time is quantifiable, yet there are simply too many variables in warfare for a commander to determine accurate estimates. As a result, it is only natural that the forecasting of time in a combat operation has been more closely associated with art, or the "genius" of war, than science.[28]

The 1993 FM 101-5, Command and Control for Commanders and Staff (Final Draft) resonates with Napoleon's caution when it notes that time "cannot be saved or gained, therefore it should never be wasted."[29] This entire monograph focuses on time -- not on time itself, but time in relation to the dimensions of space and force.[30] The nineteenth

century military theorist Jomini analyzed the geometry of war; this paper will analyze the chronology of war.

Vast improvements in military technology since Napoleon have led to tremendous increases in the range, speed, accuracy, and lethality of weapons systems, and the correspondingly increasing dispersion of combat forces. These trends have led some to assert that "the direction of force-mass in time and space to achieve the aim of a campaign becomes more difficult."[31] To a commander who must direct force through both time and space, the salient question is how to direct this force in a manner which will achieve the campaign goal(s). Synchronization is the answer.

When complex packages of forces move about and act in time and space, simultaneously and/or sequentially, their actions and efforts must somehow be coordinated. Synchronization implies, among other things, an awareness of forces in both time and space. While commanders have long used maps and graphics to enhance spatial awareness, our use of timelines to enhance temporal awareness is not as firmly established.[32] The temporal reminder in the elementary military planning acronym "METT-T" (Mission, Enemy, Troops, Terrain and Weather, and Time available), for instance, is most commonly used to consider the preparation time available until the mission begins, a necessary but incomplete tactical focus.

There are parameters to the time/space/force relationship--for instance, two soldiers cannot occupy the same exact point in space simultaneously. Further, at the lowest tactical levels, a single unit of force cannot do multiple things at once, nor can it occupy multiple spaces simultaneously. That is to say, a soldier cannot aim and shoot in different directions, nor be in several places, in the same instant.

However, the uncompromising rules of the Newtonian clockwork universe lose applicability as the units of force increase in size from soldier through army, a unit large and

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diverse enough to perform multiple functions in multiple space at multiple times. Hence, a challenging issue addressed in this paper is whether the metaphors and analogies of the tactical domain apply at the operational level.

Tempo

It is difficult to discuss the issue of time in war without addressing the related concept of tempo, or the relative pace at which an operation is conducted. Tempo, in the form of "quick, decisive victory" is often discussed as an imperative. It might even be argued that tempo generates its own combat power. For instance, Joint Pub 1, Joint Warfare in the US Armed Forces notes that in order to achieve agility, operations in all dimensions "must achieve a synchronized timing and rapid tempo that overmatch the opponent."[33]

The notion that faster is better is an intuitive yet dangerous oversimplification. As Joint Pub 3-0 points out, Joint Force Commanders (JFCs) may elect to conduct operations at a reduced pace, when enemy forces enjoy a mobility advantage, or to buy time for friendly forces not yet able to conduct decisive operations.[34] Another reason to slow the tempo might be to forestall reaching the culminating point.[35]

Control of tempo, whether faster or slower, is a way to wrest initiative away from an opponent. Colonel Dean Anderson describes this principle in a chess-like analysis:

> The theory behind current doctrine holds that we present an opponent with a series of dangerous situations to which he must necessarily react. By keeping him off balance, we will give him an opportunity to react in a manner that we can then exploit. Sooner or later, the enemy commander will come to realize that he has no moves left and will accept defeat.[36]

Hence, faster tempo might not be an end in itself; a slower tempo might conceivably benefit friendly forces in some circumstances. The ability to operate at a faster tempo is always desirable; the control of tempo is always desirable. Joint Pub 5-00.1, JTTP for Campaign Planning suggests that control of the tempo allows the Joint Force Commander

to "dominate an operation, remain unpredictable, and operate beyond the enemy's ability to react."[37] Tempo can be controlled through synchronization.

Synergy

Synergy, a desired product of synchronization, results when "elements of the joint force are so effectively employed that the total military impact exceeds the sum of individual contributions."[38] In warfare, synergy frequently works because it forces the enemy on the horns of a dilemma.[39] The US Air Force's AFM 1-1, Basic Aerospace Doctrine notes the synergy created by synchronizing the effects of operational fires and maneuver:

> If the enemy attempts to counter surface maneuver (actual or potential) by massing or moving rapidly, he exposes himself to losses from air interdiction; if the enemy employs measures that reduce the losses caused by air interdiction, he will lose or reduce his ability to maneuver fast enough to counter the maneuver of friendly surface forces. Thus, regardless of the offensive or defensive action the enemy choose to take, he faces defeat.[40]

In short, because of the synchronization of capabilities and effects, the enemy has no good move left. As Joint Pub 3-0 notes:

> the synergy achieved by synchronizing the actions of air, land, sea, space, and special operations forces in joint operations and in multiple dimensions enables JFCs to project focused capabilities that present no seams or vulnerabilities to an enemy to exploit.[41]

Beyond presenting the enemy with unpalatable options which discourage or negate his attempt to seize the initiative, synergy contributes to enemy moral and cybernetic collapse. Overwhelming and infectious demoralization occurs when the soldiers perceive themselves to be totally outmatched by continuous enemy pressure, while the enemy's command and control system is overwhelmed by "vastly magnify[ing] the complexity of the problems the enemy must solve."[42]

Friction

Synchronization is necessary to counter what Clausewitz labeled "friction." A poorly synchronized action allows more internal friction in the moving parts, resulting in a whole which is something less than the sum of its parts. A synchronized operation is the proverbial "well-oiled machine." While the product of synchronization is synergy, the waste product of friction is entropy, in which energy dissipates into wasted heat.

According to FM 100-5, "In the end, the product of effective synchronization is maximum use of every resource to make the greatest contribution to success."[43] Therefore, a principle governing time/space/force relationships might suggest that nothing is to be wasted; all force(s) should be utilized to full effect. This is a logical expression of efficiency in any endeavor, and is again not a specialized "military" application. Figure 1 depicts the proposed relationship between synchronization, friction, entropy, and synergy.

Efficiency and Effectiveness

While commanders and staff achieve efficiency in military operations through synchronization, this alone does not guarantee effectiveness. The effect of the efficiently choreographed actions must be directed in a manner which achieves the desired goal. In other words, the machine must not simply work well; it must work toward its intended purpose. This is a critical conceptual distinction between the synchronization of effects and synchronization of actions. Actions lead to efficiency; effects lead to effectiveness. We clearly need both. Sun Tsu emphasizes the latter in this passage:

> Now those skilled in war must know where and when a battle will be fought. They measure the roads and fix the date. They divide the army and march in separate columns. Those who are distant start first, those who are nearby, later. Thus the meeting of troops from distances of a thousand li takes place at the same time. It is like people coming to a city market.[44]
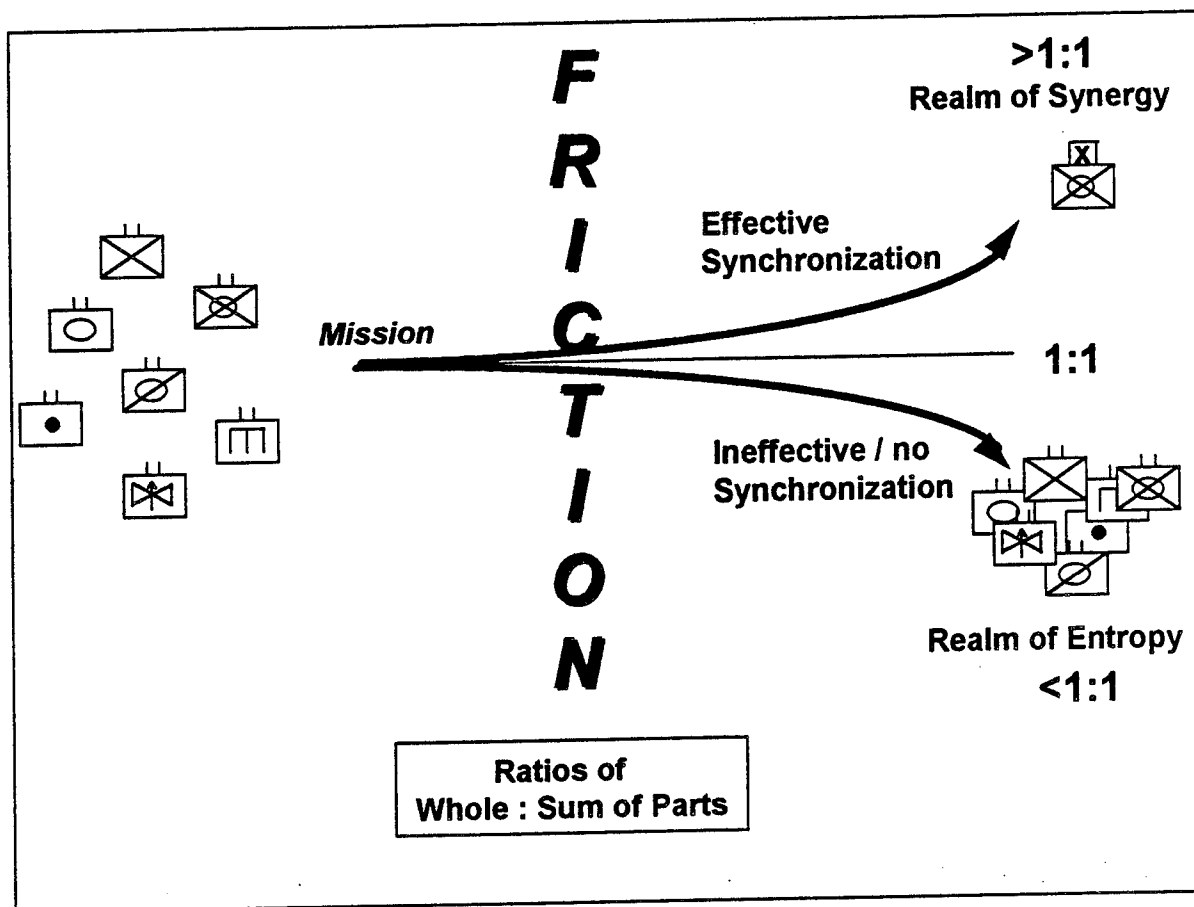
Figure 1: The Purpose of Synchronization

Recent doctrine highlights this difference. Joint Pub 3-0 emphasizes that it is ultimately the effects of operations which must be synchronized.[45] FM 100-5 specifically addresses the issue by emphasizing that synchronization "means that the desired effect is achieved by arranging *activities* in time and space to gain that *effect* [italics added]."[46]

This is not to suggest that the synchronization of actions (which some authors prefer to call "coordination") are unimportant. Both action and effect are necessary, but neither is sufficient.[47] A perfectly efficient operation can be ineffective if it is not directed toward the enemy center of gravity, while an effective operation without efficiency wastes, and possibly destroys assets (including the lives of American soldiers) which could have been used

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elsewhere or preserved. In fact, a completely inefficient operation might break down before it reaches its intended goal, however effective the achievement of that goal might have been.

Tactical and Operational Synchronization

Until now, synchronization has received the most attention at the tactical level of war. Hence, most of the definitions and understandings of synchronization are tactical, whether the authors are conscious of it or not. Yet one of the primary assertions of this monograph is that the complexities of operational synchronization cannot be fully grasped simply by interpolating from the more familiar realm of tactical synchronization.

An example of a tactical definition is found in a <u>Military Review</u> article by Colonel John B. Rogers, who narrowly defines synchronization as the "concentration of combat power at a specific time and place consistent with the commander's choice." Rogers further restricts the concept by specifically stating that synchronization is not coordinating, orchestrating or harmonizing, nor is it the concentration of forces in space.[48] Such interpretations might be described as the application of Jomini's principle of arranging "that these masses shall not only be thrown upon the decisive points but that they shall engage at the proper times and with ample energy."[49]

Clearly, there is a relationship between the principles of war and synchronization. For instance, synchronization enhances unity of effort. Synchronization is the key to massing effectively, and economy of force operations must also be synchronized. But if such tactically flavored descriptions of synchronization are really simply a translation of the principle of mass and economy of force, they may not hold applicability at the operational level of war.[50] For instance, massing generally focuses on a relatively short period of time and space.[51] Hence, operational synchronization might indeed be something substantially

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beyond simply massing "operational level" combat power at the "operational" decisive point.

Current Army doctrine more broadly states that synchronization is "the ability to focus resources and activities in time and space to produce maximum relative combat power at the decisive point."[52] AFSC Pub 2, Service Warfighting Philosophy and Synchronization of Joint Forces, similarly notes that "the goal of synchronized employment is to apply overwhelming force at the decisive points."[53] Both definitions are more inclusive than the Rogers definition; the key difference in the second definition is the potentiality of multiple decisive points. The following section will demonstrate that such modern doctrinal definitions accommodate operational synchronization more completely.

Operational Synchronization

Joint Pub 3-0, Doctrine for Unified and Joint Operations, refers to the synchronization of joint forces as "the overarching operational concept."[54] What, then, is operational synchronization, and how does it differ from synchronization at the tactical level? The Armed Forces Staff College textbook AFSC Pub 2, Service Warfighting Philosophy and the Synchronization of Joint Forces, states that:

> Operational synchronization is the arrangement of joint military actions in a given time and theater of war or operations with a given strategic purpose to produce maximum relative military power in the decisive area at the appropriate time. . . The key tool used by operational commanders to achieve synchronization of their land, sea, and air forces as well as functional systems is the campaign plan.[55]

This definition is very similar to the "tactical" definitions presented in the previous section. However, since there are distinct differences between the operational level and the tactical level which cannot be seen as proportional or linear changes, the best that can be said tactical definitions is they present a useful starting point, and nothing more.[56]

Simply in terms of scope, synchronization at the operational level is much more complex. But beyond scope, operational-level commanders and staffs are not doing the same thing as their tactical-level counterparts. Former CINCEUR General Crosbie Saint describes the distinction as one of being a shaper versus an integrator.[57] To be a shaper, operational planners must look farther out to anticipate needs. Extended time, space, and force horizons impel campaign planners to forecast and be responsive to many more possibilities.[58] For instance, some have pointed out that operational level sustainment is much more difficult, due to increasing diversification and increased consumption.[59]

A campaign planner must be acutely sensitive to the more pronounced divergence of actions and effects at the operational level. During the Korean War, General MacArthur conceived and executed Operation CHROMITE, an operational turning movement designed to cut off and trap the North Korean army besieging the US Eighth Army along the Pusan perimeter. The CHROMITE plan ably synchronized the <u>actions</u> of the X Corps amphibious assault at Inchon with Eighth Army's counteroffensive out of Pusan. However, since this plan did not synchronize the less immediate but ultimately decisive <u>effects</u> of the Inchon invasion (the moral collapse of the freshly cut off North Korean units in the south), the Eighth Army met fiercer resistance than it might have if it had delayed its breakout for another week or two.

There are several causes for missing or misunderstanding such essential differences between tactical and operational synchronization. As noted earlier, analogies that serve their purpose well at the tactical level may obscure the essence of operational synchronization. For instance, many authors, in an attempt to better discuss and teach the concept of synchronization, have employed musical metaphors such as "harmonizing" or "orchestrating."[60] This metaphor was institutionalized with the publication of a 1990 Center for Army Lessons Learned (CALL) document entitled "The Musicians of Mars: A

Story of Synchronization for the Company/Team Commander."[61] This common metaphor is misleading at the operational level, as the analogy obscures the action versus effect divergence.[62]

As the CALL pamphlet title suggests, the analogy is best equipped to deal with the lowest tactical levels, where action and effect are most likely to be virtually indistinguishable. The violinist is already assembled at the decisive place and time, and the conductor knows that the violinist's action, under his direct command and observation, will immediately produce the effect of a sound heard by the intended audience. In this case, the difference between action and effect is virtually transparent.

In order to carry the analogy into the operational realm, one must leave the current reality of the symphony orchestra. There is no symphony hall. As the operational level conductor, you have your musicians scattered at great distances, possibly intermixed with the audience. The musicians are neither moved or rerouted quickly or easily. They occasionally practice together, but are they are not "assigned" to your symphony.

These musicians are not all trained in classical symphony; some specialize in jazz, others in polka, still others in kabuki. Their powerful instruments can be heard many kilometers away, though, and after accounting for the speed of sound, you need only direct which musicians play what music at precisely what time in order to produce a suitable effect at the intended place(s). You expect your symphony to take many months to play; musicians will need to rotate in and out in order to rest and eat.

The intended operational audience is not a captive one; perhaps they would prefer to cancel the concert, or go hear a different one, or perhaps even perform their own. Maybe, somewhere in that operational audience, is your enemy. The enemy possibly has the same capabilities as yours does, and will seek to cancel out the effects of your conducting, or to desynchronize your conducting.

Obviously, the metaphor collapses under its own weight the farther it departs from reality. Yet this only demonstrates the insufficiency of comparing an operational commander's job to that of a traditional orchestra conductor. Perhaps "conducting" is but one subtask of operational level synchronization, which one previous monograph writer asserted is achieved by "setting the conditions for and the orchestration of the fighting."[63]

Is such a complex concept capable of being captured? Synchronization is a difficult multi-dimensional concept at the tactical level; at the operational level, it expands in size and form to defy easy characterization. AFM 1-1 perhaps offers the most encompassing and insightful "operational" definition of synchronization, a concept which

> . . . requires understanding the complementary and reinforcing effects of combining all available combat means, the ways in which friendly and enemy capabilities interact, mastery of time-space relationships, and unambiguous unity of purpose. . .[64]

Section III: A Framework for Synchronizing at the Operational Level

If US doctrine is not clear concerning synchronization, or more precisely, if there is a lack of clear and consistent terms, techniques, and procedures, this would tend to obscure rather than clarify the subject of synchronization in the field. Additionally, the "how to" tactical manuals have not yet been published. Once published, these manuals should present a standard synchronization model for understanding the process.[65]

Since CGSOC student Major Clyde Long wrote these words in 1989, US Army and Joint doctrinal manuals have made some progress in the terms of grappling with synchronization. At the very least, it is clear that there is an emphasis on, if not a clear understanding of, operational level synchronization.

Doctrine gives strong emphasis to the concept of synchronization. As noted in the introduction, synchronization is a key tenet of current US Army doctrine. Joint Pub 5-00.1, JTTP (Joint Tactics, Techniques, and Procedures) for Campaign Planning (Revised Initial Draft) is a new compendium of operational level concepts which suggests that "*the key operational concept* is to synchronize the actions of air, land, sea, special operations, and space forces to achieve strategic and operational objectives through integrated joint campaigns and major operations [italics added]."[66]

Despite this emphasis, some doctrinal confusion remains.[67] Definitions and descriptions are not shared between the various doctrinal publications. Some manuals describe "sequential," "simultaneous" and "synchronized" as different methods of employing forces, while other manuals use the terms as if some of these as the subset of the other.[68] Major Michael Haith noted that "synchronization is frequently misunderstood to mean the same as coordinate, integrate, or harmonize. . .these terms are used interchangeably in doctrinal publications."[69] Significantly, the latest version (1989) of Joint Pub 1-02, DoD Dictionary of Military and Associated Terms, specifically intended to standardize military terminology among the services, contains no definition for the word. Since there is no

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single coherent framework for understanding synchronization, the term is highly susceptible to gratuitous application as a trendy buzzword.

Possibly the greatest shortfall that remains is that published doctrinal techniques and procedures for operational synchronization are quite limited. At the tactical level, ST 100-9, The Tactical Decisionmaking Process and the latest draft of FM 101-5 recommend the use of a synchronization matrix to assist in during the wargaming of a course of action. This is a two-dimensional matrix or spreadsheet upon which unit activities across time are noted, categorized either by subordinate units (forces) or by the Battlefield Operating Systems (BOS) (functions).

At the operational level, Joint Pub 3-0 appears to provide a list of synchronization techniques:

> Campaign plans synchronize efforts on land, on the sea, in the air, and in space. They do this by establishing command relationships among subordinate commands, by describing the concept of operations, by assigning tasks, and by task-organizing assigned forces.[70]

Unfortunately, the utility of such doctrine is constrained by its generality. Several monograph authors have criticized this same passage for its "absence of useful operational processes," which are "not likely to help [the commander] accomplish those specific tasks."[71] It is a goal of this paper to increase the level of specificity and practicality of operational synchronization beyond that provided in doctrine.

There are some useful points of departure, however. A model for analysis is provided in AFSC Pub 2, which asserts that "[Joint synchronization] includes the vertical integration between echelons of functions within each of the six theater operating systems and the horizontal integration of the operating system across theaters in time and space to maximize combat output."[72] The first part of this definition (vertical integration between echelons)

simply reminds us that unity of effort must be obtained by ensuring that each echelon, from the individual aircraft or squad up to theatre level, is in acting on a common plan.[73]

The remainder of this definition requires further exploration. A 1990 SAMS monograph by Major Timothy D. Lynch entitled "Operational Synchronization: A Revised Doctrinal Perspective" makes a valuable and insightful contribution by creating the "TMFAE Paradigm" for understanding synchronization.[74] Lynch asserted that synchronization could be understood in terms of Time, Mediums, Forces, Actions, and Effects. This paper will build from Lynch's work and the AFSC Pub 2 definition by investigating each of these aspects and their relationship to operational synchronization.

Our primary task in the remainder of this chapter is to add a degree of specificity to this model by investigating concepts related to each of the dimensions of synchronization: space, time, and force/function.

Synchronizing Space at the Operational Level

Military commanders and planners are accustomed to using maps to aid their "visualization" of the battlefield, or the campaign. Hence, space, which can be seen and therefore sensed more readily than time, is traditionally the heart of tactics, operations, and strategy.

A common way of conceptualizing space is to divide it into dimensions, as exemplified by the recently retired doctrinal label "AirLand Battle." At the tactical level, for instance, Army staff officers are taught to think in terms of a battlefield framework which divides the battlefield into close, deep, and rear. At the operational level, Joint Pub 3-0 notes that "JFCs [Joint Force Commanders] integrate and synchronize operations in a manner that applies force from *different dimensions* to shock, disrupt, and defeat opponents [italics added]."[75] But what are these dimensions? A common approach, as suggested by

Lieutenant Colonel James M. Dubik in his "Guide to the Study of Operational Art and Campaign Design" is to view joint operations in terms of the dimensions of air, land, and sea.[76]

These mediums are discrete, observable, and definable, and governed by vitally different physical properties, advantages, and limitations. Of course, this traditional trichotomy is not immutable. For instance, given the capabilities of the modern US Armed Forces, it is not unreasonable to separate "space" from the dimension of "air." Likewise, naval operations further divide the sea into "surface" and "subsurface."

Dubik's approach is all the more palatable since it corresponds closely with the manner in which are independent service components are arranged--the army, the navy, and the air force. But there is a danger to basing the "partitioning" of the theatre along service lines. When the focus of dimensions is organizationally driven instead of requirements-based, the distinction between force and space either becomes irrelevant or unhelpful. For instance, Joint Pub 3-0 seems to suggest treating Special Operating Forces (SOF) as a dimension, even though these are unique forces applied in the conventional dimensions of land, air, and sea.[77]

Beyond the impact of current service roles and missions, the conventional dimensions of space (land, sea, air, and space) may serve as blinders. Do these categories need to be physically observable and distinguishable? AFSC Pub 2 suggests considering synchronization throughout the "realm" of "the electromagnetic and acoustic spectrum, or as some agencies have referred to it, the electronic battlefield."[78] Major James K. Greer's SAMS monograph "Operational Art in a Multi-Medium Environment" asserts that "warfare is currently conducted in at least six mediums: land, sea, air, psychological, space, and electro-optical."[79]

Is it a legitimate stretch to treat the electro-optical and psychological dimensions as spatial dimensions? Perhaps not, in the strictest sense of the concept of physical space -- but a better question would be: is the traditional self-imposed framework of physical space still useful? A soldier on the modern battlefield can be simultaneously targeted through all six media.

The use of the term "medium" need not be limited to an existing physical dimension--it can imply an available mode of transmitting power. There are undoubtedly other media which remain undiscovered by the current state of technology and imagination. Since the electro-optical and the psychological media are in fact methods for applying force with various units and equipment in our modern military forces, this paper will move beyond the physical interpretation of "space" and endorse Greer's multi-media framework.

Synchronizing Time at the Operational Level

In comparison to space, our minds have more difficulty conceptualizing in time, the "fourth dimension." Occasionally, efforts are made to portray space across time; for instance, planners often employ sequential graphics to display the status of forces in space across different phases of time. Intelligence collection planners are doctrinally taught to use TPLs (time-phase lines) on event templates to portray where and when to look for indicators of enemy courses of action.[80]

Do operations necessarily have to occur across significant amounts of time? Given the choice between fighting in time or achieving the goal relatively instantly, a commander would probably prefer a single simultaneous action which "contributes directly to an enemy's collapse by placing more demands on enemy systems than can be managed."[81] In a "perfect" war, perhaps simultaneous actions, benefiting from surprise, might instantly achieve their objectives and hence be strategically decisive. This was the case in Operation

El Dorado Canyon over Libya in 1986, or the 1993 retaliatory Tomahawk strike on the Iraqi Intelligence Headquarters, and was virtually the case in Panama in 1989.

Simultaneity may also be difficult or impossible to achieve because we lack the military resources in relation to the goal. FM 100-5 notes that "synchronization implies judgment in choosing among simultaneous and sequential activities."[82] A foe deployed in depth and strength makes himself immune to defeat in a single operation. For anything other than a fairly limited objective or a relatively vulnerable opponent, US forces at the operational level are organized to go to war sequentially "because of limited resources, geographic considerations, and our system for organizing the force."[83]

An alternative to simultaneity is sequencing an operation. This concept is central to the notions of campaigns and the operational level of war. According to AFSC Pub 2, a campaign is "a *sequence* of related military operations aimed to accomplish a common objective, normally within a given time and space [italics added]."[84] Since our aim is to synchronize forces in space through time, time must represent at least one axis of a synchronization model.

Sequencing operations is not simply an attempt to make a virtue of a necessity. Strategic considerations may make surprise and simultaneity unattractive; perhaps military power is only supporting a "main effort" through the exercise of diplomatic, economic, or informational power. As is evident from NATO's policy in Bosnia today, political leaders may desire to wade in slowly, steadily turning up the heat just enough to achieve immediate objectives while hoping that other elements of national power can achieve the strategic aims.

Sequencing implies thinking in time. Time is divided into rather discrete, precise packages at the tactical level -- hours, or even minutes and seconds. Campaign

commanders and planners, who must forecast much farther but with less precision than the battle captains, are likely to use a unit of time of days or greater.[85]

But these units of days or weeks have no inherent meaning apart from how they fit into the plan. The commonly accepted method for managing time in a campaign is through the use of phases, a method for operational-level commander to "organiz[e] the extended and dispersed activities of the campaign or major operation into more manageable parts that allow flexibility in execution."[86] Phases improve upon a strict calendar-like approach to time because they group packets of time into discrete, functionally relevant categories which readily inform commanders and staffs of the thrust of that phase. Such phases, which FMFM 1-1 defines simply as "event oriented guideposts,"[87] can be organized by types or tempos of their operation.[88] While the concept of phasing has become virtually institutionalized in the campaign plan, there is no single doctrinally approved set of phases. Doctrinal manuals are careful to note that there is no one set, and that it will depend on the unique circumstances. Figure 2 depicts some of the proposed groupings of time with respect to operational activities.

Phase	JTTP 5.00-1[89]	FM 100-5[90]	Dubik[91]
I	prehostilities	mobilization	planning
II	initiation of hostilities	predeployment activity	mobilization
III	sustained ops	deployment	deployment prep
IV	pre-termination	entry operations	deployment
V	post-termination	operations	rehearsal
VI		war termination, postconflict opns	conduct
VII		redeployment, reconstitution	redeploy prep
VIII		demobilization	redeploy
IX			recover

Figure 2: Examples of Phasing Campaigns

Synchronizing Force and Function at the Operational Level

Our final task is to determine just what is being synchronized across time and space at the operational level. This is more difficult than it sounds; even at the tactical level, there is considerable variance of opinion as to whether subordinate units or battlefield operating systems are the units of choice depicted against a timeline. What is synchronized--forces or functions? AFSC Pub 2 allots a chapter to both "Synchronization of Forces" and "Synchronization of Functions," and implicitly asserts their coequal status by noting:

> The theatre CINC applies operational art to the planning and execution of his campaign plan not only by synchronizing forces but also by synchronizing many operational-level activities. These key activities have been termed operational functions or theatre operating systems . . . This functional approach is by no means the only way to look at the tasks required at theatre level, but this approach allows for an analysis of the many complex tasks required.[92]

It should be noted, however, that AFSC Pub 2 defines "forces" as air, land, and sea forces. Since the method of dimensioning space accepted in the previous discussion already accounts for these forces, this is redundant information with no value added beyond what might be inferred from their medium. For instance, a century ago, land forces acted and had effects on the land while naval forces acted and had effects almost exclusively at the sea.

Of course, forces operating in different media now regularly interact, so the "forces = space" shortcut is unsuitable for modern combat. Therefore, the model should incorporate what force is being synchronized, even if only in terms of a unit designation. However, since any given force can have multiple functions in multiple media, that force's function(s) should also be specified.

An existing framework is provided by TRADOC Pam 11-9, Blueprint of the Battlefield, which defines a function as "activities or processes that occur over time without implying how they will be accomplished or what instruments or methods will be used to perform them."[93] This reference lays out a framework for operational-level functions through the

description of six Operational Operating Systems (OOS): movement and maneuver, fires, protection, command and control, intelligence, and support. It is this framework which is adapted in Chapter 5 of Section 2 of AFSC Pub 2, "Synchronization of Functions."

Earlier in this paper, we noted that both actions and effects must be synchronized. Forces act (or function); these actions produce effects. Therefore, a comprehensive operational synchronization matrix should synchronize not only forces and functions, but also effects.

A Format for Dynamic Synchronization

The previous sections demonstrate that the concept of operational synchronization is complex and unwieldy. According to this analysis, commanders and their staffs must be conceptualizing, or "visualizing" across multiple forces and functions, and their actions and effects through space (or media) in time. Can the complexity of synchronization be portrayed? What format will best serve this purpose?

At the tactical level, the synchronization matrix is used. Common variations of the matrix display either BOS functions or subordinate units (forces) across a timeline. But there is no doctrinal solution to the dilemma of selecting what to synchronize on the matrix, either at the tactical or the operational level. FM 101-5 describes the purpose of the synchronization matrix, but not the format.[94] Dubik's "Guide to the Study of Operational Art and Campaign Design" and Becker's monograph "What is an Adequate Decision Support System for the Operational Level of War?" offer choices of multiple formats based on forces and functions across time, but articulate no rationale or theory for adapting any given format in any given situation. Figure 3 depicts some of the possible choices in designing a synchronization matrix for the operational level.

A particularly telling piece of data is found in the widely acclaimed MMAS thesis by Major Clyde Long entitled "Synchronization of Combat Power at the Task Force Level: Defining a Planning Methodology." Long's tactical synchronization matrix received high marks for utility when it was pilot tested with former commanders, doctrine writers, and CGSC instructors. Yet Long reported that "the greatest disagreement noted during analysis of the survey results concerned the design of the matrix." Fifteen out Long's forty respondents recommended changes to the design of the proposed matrix, which was based on synchronizing the BOS across time.[95]

Long concluded that any single standard design might be difficult to achieve, and proposed an alternative version based upon synchronizing the BOS within each of the areas of the battlefield framework: deep operations, security operations, main battle area
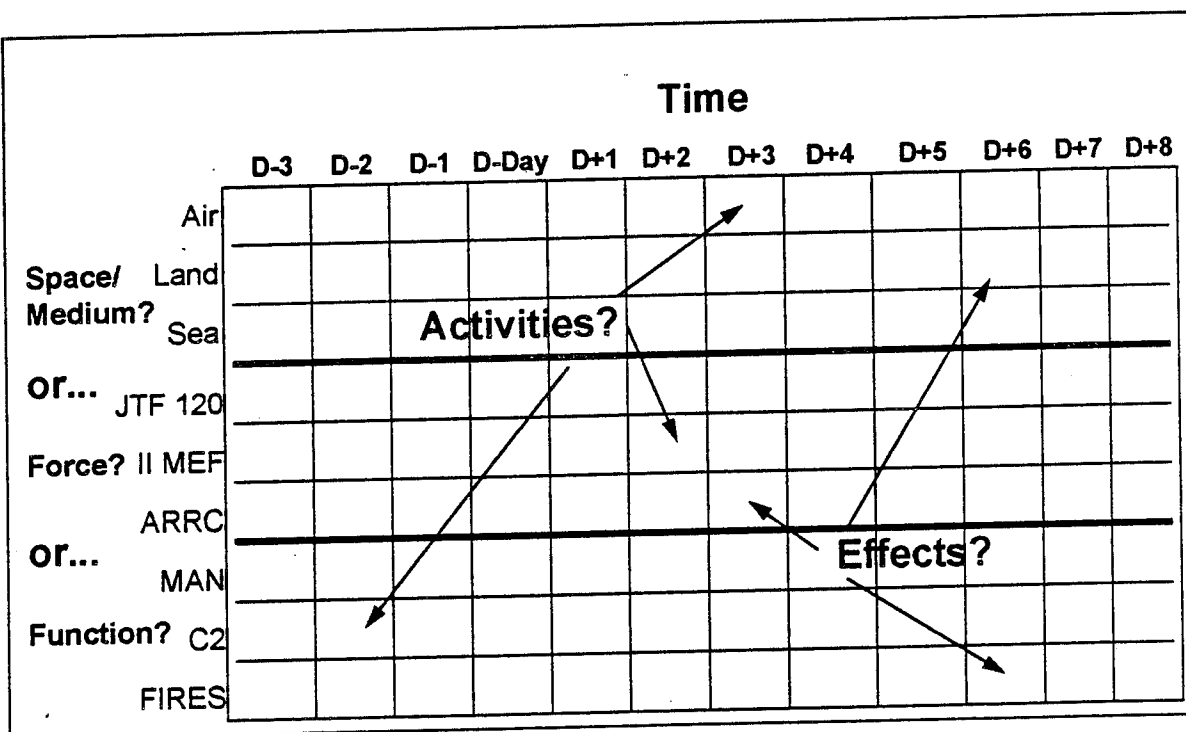

Figure 3: Choices in Designing a Synchronization Matrix

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operations, rear operations, and reserve operations.[96] In other words, Long considered categorizing in terms of function by space.

Even this alternative format relies on the BOS. One criticism of synchronizing functions was expressed by Colonel (now Major General) Don Holder, who cautioned against subscribing to a format which separates components which are necessarily linked.[97] The most common alternative to synchronizing battlefield operating systems (functions) by time, synchronizing by subordinate units (forces), might reduce this particular problem.

One limitation assumed in this discussion is that there is only one other dimension which can be juxtaposed on the time dimension. This is a two-dimensional problem, limited by the available dimensions of a flat sheet of paper. But why force a choice which will limit information in order to conform to a limitation which can be overcome? Surely, the forgoing discussion has demonstrated that operational synchronization has expanded beyond a two-dimensional problem.

Achieving a tool which assists in such judgments is the premise which leads to the development of the Dynamic Synchronization Matrix. A computer program is not limited to two dimensions. It can make connections between time, space, forces, functions, actions, and effects which the average human would have difficulty making and storing. It can record and display synchronization information in multiple tailored formats with the touch of a mouse. There is no need to "choose" to limit one's synchronization any more. The automated synchronization matrix is not a pipe dream; the following chapter will document its creation.

Section IV: The Dynamic Synchronization Matrix

Part of the problem we face today is that our command and control tools have not kept up with the increasing complexity of the battlefield. When I visited General Frederick M. Franks in the Gulf, he showed me the helicopter he used as a mobile command post during the war.

What I saw inside was not unlike command posts I have seen since entering the Army 30 years ago; a map mounted on plywood and covered with plexiglas; acetate overlays attached with green tape; a clipboard for reports. Our command and control tools are lagging behind the expansion of the battlefield.[98]

--General Gordon Sullivan

As our collective military culture becomes increasingly aware of the evolving power of the computer, some have suggested that one of the next steps in enhancing command and control is to automate the synchronization matrix.[99] Before presenting one such solution, which I call the "Dynamic Synchronization Matrix," it will be useful to review what other Army systems support automated synchronization.

The primary automated command and control system at the operational level is known as the Joint Operation Planning and Execution System (JOPES). While this vast and cumbersome system might be seen as supporting automated synchronization, the practical focus of the system is on logistics and deployment, and not employment. Furthermore, the unfortunate consensus among those experienced with the system is that JOPES is broken, serving as a self-inflicted source of friction.

Automated synchronization at the tactical level is approached, but not achieved, by some current Army automation initiatives which feature the integration of a timeline into their array of tactical decision-making aids. The "Operations Planning Tools" (OPT) is a prototype set of staff planning aids which features a "timeline" function. This feature essentially acts as a time-phase line, projecting tactical unit locations at given times in the battle.[100]

Similarly, the "Army Tactical Command and Control System" (ATCCS) features an execution timeline and matrix in its OPORD prototype. This function extracts unit tasks by time from the base order and displays them in the familiar synchronization matrix format.[101] While these are measurable steps forward, such timeline and synchronization tools lack the functions required for synchronization at the operational level.

Perhaps the most promising automated synchronization matrix at the tactical level is found in an ongoing independent project by MAJ John Carrano, a current student in the Command and General Staff College. Major Carrano has developed an ambitious and powerful prototype for a comprehensive tactical command and control system which he calls the "Tactical Data Assistant." In an independent study paper, Major Carrano previews his vision for how such a system would enhance decision-making and command and control for the battalion level commander and staff.[102]

Although the thrust of the project is on the synchronization of staff planning functions prior to the execution of the plan, Carrano's methodology captures the capabilities of automation more fully than the current OPT or the ATCCS systems. This methodology, called PERT, is a critical component of a Dynamic Synchronization Matrix.

PERT as a Decision Support Method

CGSC Student Text 25-1, Resource Planning and Allocation, defines PERT (Program Evaluation and Review Technique) as a program management technique which

> uses a network to depict logical or resource-constrained relationships among activities or tasks (subdivisions of a larger process or project) and events (distinguishable points in time that coincide with the beginning and/or end of activities, checkpoints, or milestones). [103]

Far from being new to military applications, PERT (sometimes also referred to as network planning, or the critical path method) was in fact originally designed in the 1950's

to improve efficiency in the post-Sputnik rushed production of US Navy's Polaris submarine program.[104] While automation is not required to conduct a PERT analysis, commercial project management computer programs are now available.

Significantly, the Soviet Army relied on both manual and automated PERT as a key tool in their highly advanced system of automated troop control (*Automatizirovannaya sistema upravleniya voyskami*, or ASUV).[105] The employment of this technique was not limited to the tactical level; Soviet planners also used PERT to sequence major operations at the operational level of war.[106] One Soviet writer's enumeration of the PERT-induced analytical process reveals its utility in campaign planning:

1. What tasks must I accomplish to achieve the objectives?
2. What are the logical relationships between the tasks?
3. Which battles can I conduct simultaneously?
4. Which operations must I conduct sequentially?
5. What resources are required to conduct the operation?
6. What impact does changes to my plan affect the achievement of objectives [*sic*]?
7. Which operations must I control carefully to insure success?[107]

Similarly, our own ST 25-1 notes the following benefits to network analysis:

- Planners are forced to explicitly state assumptions about activities' logical sequence.
- Resources (manpower, equipment, funds, facilities) can be analyzed and scheduled.
- Subordinates have a graphic representation of their tasks and the tasks' relationships to the overall project.
- The impact of proposed changes can be quickly analyzed.
- Commanders and managers can control project execution.[108]

Some may forcefully reject the notion that a "scientific" project management technique has any applicability in the domain of war. However, no attempt is being made to assert that PERT analysis has any unique capability to counter a willful enemy capable of initiative, nor can PERT sweep away fog and friction. PERT itself cannot guarantee that a campaign plan is effective; that evaluation remains a human judgment. PERT analysis is simply being proposed as a more efficient way of doing that which doctrine tells us staffs at the

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operational level are already doing while developing a campaign plan: synchronizing the operation.

A Philosophy for Decision Support Tool Design

The following section outlines the specific assumptions and goals which drove the development of the Dynamic Synchronization Matrix.

Achieves something tangible now. Other authors have suggested that automation of the synchronization matrix is the next step, but almost no one has actually taken that leap. An immediate, short term improvement in our staffs' ability to plan and control synchronization, no matter how modest an increment, is the "earnest money" which may encourage others to take this concept farther toward an ideal solution.

Serves as a decision support tool. PERT, whether automated or manual, is not "artificial intelligence" nor an "expert system;" it is nothing more than a disciplined and logical method of organizing actions in time and space. The Dynamic Synchronization Matrix proposed in this paper, based upon automating the PERT methodology, is nothing more or less than a decision-making tool or aid to the commander and staff. Campaign staffs are not surrendering control to a machine.[109] Far from taking decisions away from commanders, the DSM should, in fact, prompt them.

Designed by a computer novice for other computer novices. A common complaint cited by critics of computer encroachment into military staff work is that a significant, sometimes unreasonable, amount of training is required to maintain proficiency on the system. A lesson should be taken from JOPES: when the system is too difficult to learn, senior officers do not rely on it and the system is in effect not utilized.[110] Trained operators become a commodity, and become "specialists," unable to keep track of the big picture. The term "CRT (Cathode-Ray Tube) fixation" is a term coming into vogue in Army

parlance; it is an increasingly common evaluative diagnosis for staff officers unable to adequately interpret and fuse relevant data and produce results.

It is critical that the Dynamic Synchronization Matrix is a simple, user-friendly system, for "automated procedures must be simpler to perform than the manual procedures they replace, or they simply will not be used."[111] Hence, this program is nothing more than the adaptation of an off-the-shelf program. This stylized windows-compatible commercial spreadsheet, can be run on any government or personal 386 or 486 laptop computer.

Takes full advantages of computer "brute strengths." Computers do not do everything (at least not yet), but they are capable of doing certain tasks much better and quicker than corresponding manual systems. Army Research Institute Research Product 91-09 enumerates three areas in which "computer tools could best provide support relative to what humans do best."[112] These areas are: presentation support for aiding visualization; computational support for aiding estimates; and organizational support for aiding information management. Each of these capabilities will be exploited by the Dynamic Synchronization Matrix.

Another relative strength of a decision support tool, manual or automated, is that it can help minimize the boredom associated with time-consuming, frequent activities. Furthermore, cognitively demanding activities such as synchronization are particularly susceptible to degradation under conditions of stress and sleep loss. As Joint Pub 6-0, C3 Systems Support to Joint Operations notes:

> C4 [Command, Control, Communications, and Computers] systems must be planned as extensions of human senses to help people form perceptions, react, and make decisions. This allows humans to be effective during high-tempo operations.[113]

The Dynamic Synchronization Matrix

In order to improve the techniques available for synchronizing at the operational level, I have tailored an existing computer program into an application which I call the "Dynamic Synchronization Matrix (DSM)." The DSM is a specialized application of the commercial computer project-management program <u>Microsoft Project</u>. This program employs PERT methodology to the management of projects. These excerpts from its literature demonstrate that <u>Project</u> is targeted towards a business, and not a military, application:

> . . . a powerful and easy-to-use graphical program that helps you with planning tasks, allocating resources, costing, tracking, and reporting. . . . Microsoft Project simplifies project management with interactive graphics, lets you enter and view information in a variety of ways, and is easily customizable to meet your particular scheduling needs.[114]

This program was readily customized into a Dynamic Synchronization Matrix. The procedure for customizing the program to the current application is detailed in Appendix A. Examples of this matrix are provided in Appendix B.

Value Added to Operational Synchronization Techniques

The DSM is a synchronization matrix with enhanced capabilities. Theoretically, it introduces no new insights to the staff that is not already achievable (assuming that campaign staff is properly and religiously using manual synchronization matrices). Practically, however, the DSM will improve upon existing capabilities because it combines the two distinct major improvements of PERT methodology and automation. The net gains are enumerated below:

1. <u>Planning is disciplined by adherence to PERT methodology.</u> In order to complete the DSM, planners must explicitly state the various linkages and assumptions inherent in each task. To some, this effort reflects the essence of operational art, not its antithesis. <u>FM 100-5</u> notes:

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Operational art seeks to ensure that commanders use soldiers, materiel, and time effectively to achieve strategic aims through campaign design. Such a design provides a framework to *help the theater and operational commanders order their thoughts.*[italics added][115]

As <u>AFSC Pub 2</u> notes, "Each phase is an essential component in a connected string of events, related in cause and effect."[116] PERT requires that the estimated time to complete tasks is input, as well as the preconditions that must be in effect for each task. If the tasks in each phase do not set the condition for subsequent phases, PERT highlights the shortfall. Nevertheless, the DSM does not demand precision where it does not exist. The DSM is as amenable to an estimate, a guess, a hunch, of the progression, duration, or presumed connection between actions and effects as is a manual synchronization matrix.

The DSM also allows planners to ensure that the phases achieve the desired strategic goal or endstate. <u>Joint Pub 3-0</u> notes that:

Operational art helps commanders understand the conditions for victory before seeking battle, thus avoiding unnecessary battles. Without operational art, war would be a set of disconnected engagements, with relative attrition the only measure of success or failure.[117]

Hence, the DSM serves as a method of checking if the ways and means employed by a plan will achieve the ends.

Of course, manual synchronization techniques should accomplish these checks on the cause and effect linkages between tasks -- but the DSM serves as an unforgiving second opinion on the logical assumptions behind the operation. As <u>FM 100-5</u> suggests, "Synchronization implies judgment in choosing among simultaneous and sequential activities. Commanders must make this distinction clear to their staffs and subordinate commanders when effects of one activity are a precondition for subsequent action."[118]

2. <u>Flexibility in subsequent planning and execution is enhanced.</u> <u>Joint Pub 5-0, Doctrine for Planning Joint Operations</u> notes that flexibility is a principle of planning.[119]

This has been difficult for operational staffs because the JOPES/WWMCCS system has been criticized for lacking flexibility because the products "do not allow for easy analysis or changes."[120]

Contrary to what might be expected of a plan disciplined by PERT methodology, the power of automation actually makes it much easier and quicker to analyze and react to the impact of any change to the plan, whether due to friction, enemy action, or a commander's decision. For instance, the effect of a unit's failure to accomplish a mission within the projected time can be analyzed for its total impact on the campaign plan, and subsequent adjustments can be made, if necessary. Hence, a real advantage of using the DSM in planning is that the synchronization plan for branches and sequels can be generated with relative ease.

3. Multiple display options are available which can be tailored to specific requirements. Manual synchronization matrices display only what information is placed upon them. One of the real strengths of the DSM is its ability to implicitly "embed" all the relevant data associated with an event in the program, independent from the manner in which the program is displayed. In other words, for each activity, the program records the activity itself, the executing or responsible subordinate force, the applicable OOS function(s), the start time, completion time, and duration of the activity, the phase, and the connections with all other activities and events associated as either predecessor, parallel, or successor tasks. Finally, although the version in this monograph is not configured to do so, it is possible to record the logistics requirements for any activity, hence allowing visibility into the support requirements needed to sustain the assigned tasks of any unit.

With a manual synchronization matrix, it is difficult and time-consuming to tailor different formats to meet different needs of the command. As a result of the embedded information, the staff may quickly produce a DSM format which portrays any subset of the

above data, sorted in any order, arranged in any way. For instance, a subordinate commander could receive a matrix listing only those tasks assigned to him, or the JFACC could request a matrix of all operational fires tasks for a given phase.

Furthermore, the DSM allows a format to be chosen which "zooms in" to a greater level of detail, or provides a less detailed (but just as precise) overview of the operation. The implications of this inherent flexibility go beyond formatting and display issues; planners can easily customize the program to meet needs unforeseen by this author. Examples of various DSM formats for a given plan are displayed in Appendix B.

4. Greater speed, agility, and accuracy are achieved with less degradation. According to Joint Pub 5-0, timeliness is a principle of planning.[121] As noted earlier, automation allows the impact of actual or possible changes to the plan to be quickly reflected in the DSM. As a result of this decreased reaction time during planning and execution, the DSM better achieves the doctrinal tenet of agility, an imperative defined in FM 100-5 simply as "the ability of friendly forces to act faster than the enemy."[122]

After the initial setup, the DSM is quicker and easier to produce, update, and manage than its manual counterpart. This should represent a significant improvement in campaign staff performance, if feedback from tactical staffs is any indicator. According to one study of the tactical decision-making process:

> This synchronization matrix is often not used correctly or not used at all due to time compression and the fact that it is mildly complicated. The difficulty in using this manual tool is attributed to staffs, as seen at NTC, which are often tired and deprived of sleep. The use of such tools requires a high degree of cognitive awareness that most of the staff officers lack after several days of continuous operations.[123]

5. Situational awareness is enhanced. According to Joint Pub 6-0, "the ultimate goal of C4 [command, control, communications, and computer] systems is to produce a simultaneous situational visualization that is accurate and meets the needs of the system's

various users."[124] One of the most significant biggest advantages of a completed synchronization matrix, whether manual or automated, is enhanced situational awareness for the command.[125] As a result of the increased flexibility and speed cited previously, as well as the multiple display formats, the DSM will achieve and maintain situational awareness more adeptly than its manual counterpart.

6. Information management is enhanced. Like JOPES, the DSM also serves as a data base. Various complex operations, such as an amphibious operation or a Joint Precision Strike (JPS), can be templated at a generic level, or restored from a previous similar activity, and then adjusted to meet the demands of a particular operation. An unlimited number of branches and sequels can be quickly planned from any decision point in the operation.

7. Provides insights into own plan. PERT methodology provides insights into those tasks which are along the "critical path"; that is, activities which define the total length of the project. Conversely, those tasks whose duration does not affect the total duration of the operation are said to have "slack time." Hence, the PERT network alerts planners to those tasks which are time sensitive, and those which are not.

In some campaigns, time may be the critical consideration. For instance, it may be necessary to complete a phase of the campaign before the end of a season, or before the enemy is believed to be able to mobilize his reserves. Therefore, although not a traditional use of the synchronization matrix, it appears possible in these instances to identify one's own center of gravity by understanding what critical tasks must be accomplished on time if the operation is to proceed according to the plan.

Since the DSM suggests those tasks which are more critical to success, planners can use the insights gained to generate Friendly Forces Information Requirements (FFIR),

information which the commander must have about his own units in order to make decisions.

Similarly, the DSM can provide insight into the culmination point of one's operation, most notably by considering the most effective synchronization of logistics capabilities and requirements for a campaign. As <u>Joint Pub 3-0</u> notes, "synchronization of logistics with combat operations can forestall culmination and help commanders control the tempo of their operations."[126]

8. <u>Capable of providing insights about enemy strengths and vulnerabilities.</u> Just as the DSM can reveal insights about the assumptions and limitations in the friendly plan, a DSM reflecting the most dangerous and most likely enemy plans might reveal valuable information on how to defeat him. A DSM analysis of the enemy, perhaps done by the J-2 section of a campaign staff, might identify enemy centers of gravity along the timeline of his most likely plan, and allow the staff to develop a plan which desynchronizes the enemy or brings him to culmination.

9. <u>Provides linkage and applicability to subordinate echelons and other levels of war.</u> The DSM methodology, with minor modifications (such a timeline that reflected minutes and hours instead of days and weeks) could be applied to synchronize tactical operations. At the strategic level, a DSM might help synchronize the military instrument of power with other instruments of power available to the NCA.

Furthermore, because of the "zooming-in" function of the DSM that allows up to ten subordinate echelons of detail (with an option to display any or all of these levels of detail), it is possible to maintain subordinate units' plans to ensure that each dovetails with the operational-level plan.

Section V: Recommendations and Conclusions

Recommendations

The DSM is a first generation program. Although it may enhance the effectiveness of operational synchronization, the DSM also leaves much room for future improvements. No attempt has been made to adapt the DSM to hardware which achieves connectivity and standardization with other Army and Joint systems. For instance, it would be particularly useful to allow the DSM to link with the deployment data, so that troop and equipment flow into the theatre could be better managed and updated from TPFDLs.

Another enhancement might be to add a capability to manage logistics consumption by task and unit within the DSM. Conceivably, a database drawn from references such as FM 101-10-1/1 and FM 101-10-1/2, Staff Officers Field Manual Organizational, Technical, and Logistical Data (Volumes 1 and 2) could automatically compute sustainment requirements for planned operations.

Joint Pub 3-0 notes that synchronization must include also the use of political and informational elements such as government agencies, non-governmental agencies, and multinational actors, when appropriate.[127] It might be useful to explicitly incorporate these elements into future versions of the DSM.

Finally, there were some limitations imposed by the program chosen. Only so many fields were available for adaptation as pieces of data, and display presentations were somewhat limited. It is likely that either future versions of commercial project management software, or a project designed to customize PERT methodology to the issues of operational synchronization can easily overcome this difficulty.

A note of caution is in order. Some have argued that automation may lead to overcentralization of control.[128] Clearly there is a delicate balance between inadequate

control of an operation and overcentralization of that same operation. The DSM should serve only to improve the efficiency of existing necessary control measures, and should not be used as an excuse for increased centralization and control. In other words, the DSM should be viewed only as a better way to accomplish the existing task of synchronizing operations, not as a new task.

Conclusion

> Numerous fruitless decisions unsupported by materiel and linked with a great deal of blood and few victories characterized the activity of Russian generals . . . Operational art not only must, but can also, be subjected to known rational substantiation.[129]
>
> —V. K. Triandifillov

The Dynamic Synchronization Matrix is a decision support tool which capitalizes on a combination of PERT methodology and automation to enhance a campaign staff's synchronization efforts. The methods in which the DSM should offer significant improvements over manual synchronization methods were enumerated in the last chapter, and will not be recounted here.

Ultimately, many arguments against adaptation of the DSM may well be more emotional than rational. Undoubtedly, some will point to the dangers of increased quantification and automation of warfare, arguing that techniques like the DSM cannot adequately capture or foresee those intangible elements commonly accepted as the domain of the art of war. Some may cite the "tyranny of the spreadsheet and Vietnam."[130] There will always be adverse reaction in some quarters to anything appearing to quantify what has traditionally been assumed to be beyond capture except by the realms of art and genius.

Therefore, it is once again important to stress that the DSM is recommended only as an improvement over something we should already be doing at the campaign staff:

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synchronizing operations. The DSM is not encroaching into new areas; "we must keep saying to ourselves, and to each other, that computers are only tools of C2, just like grease pencils, acetate, status boards and field phones."[131]

The DSM simply reduces the physical and cognitive workload required to synchronize operations. Such a philosophy would be readily accepted by the Soviets, who did not view their automated troop control organs as impediments or usurpers:

> Soviet military writings make it quite clear that coordinated command demands control of events and processes. Automation is not designed to displace military skills or override competent staff work. The logic behind Soviet troop control is that staff planning and decision making can be facilitated by decision aids. The is notion that commanders and staffs can be freed from the resource estimation process and more time can be allocated to the judgment process.[132]

The Dynamic Synchronization Matrix, while by no means a perfect tool, represents a step forward in providing campaign staffs with the decision support tools they need in order to improve operational level planning and execution for the employment of joint US military forces. It is sincerely hoped that such staffs may benefit from its use today, and that the DSM has the potential to provide impetus to better products in the future.

APPENDIX A: CUSTOMIZING MICROSOFT PROJECT

The Purpose of this appendix is to document the manner in which Microsoft Project, Version 3.0a, was customized to form the Dynamic Synchronization Matrix. Because the program is designed for business applications, some of the terminology is confusing. Table 1 notes some of the major terms and a suggested translation of their commonly understood campaign planning meanings.

PROJECT Terminology	Equivalent Campaign Staff Terminology
Gantt Chart	Synchronization Matrix
Tasks (critical and non-critical)	Mission, activity
Resource Names	Subordinate Units, Commands
Milestones	Endstates, Effects, Conditions
Summary Tasks	Phases
Predecessor task	Precondition
Successor Task	Follow-on mission
Text1	Operational Operating Systems (OOS)

Table 1: Terminology Differences

Users new to Microsoft Project are encouraged to begin a DSM by selecting **HELP-PLANNING WIZARDS** and following the step-by-step instructions for beginning a project. However, once you have opened a new project, there are certain default settings in effect. This section suggests changes to standard settings more appropriate to campaign planning. The changes documented in the following section were used to form the example DSM displayed in Appendix B.

This section is arranged in the order in which functions are arranged on the tool bar at the top of the screen.

FILE:

PAGE SETUP:

MARGINS: .2 inch all around
                    ORIENTATION: portrait
                    BORDERS: none
                    HEADER: (Name of Campaign, Headquarters)
                    FOOTER: none

EDIT: No changes necessary.

VIEW:

During normal use, the default display is appropriate: **Gantt Chart** on the top half of the screen, and **Task Entry** on the bottom half.

TABLE:

DEFINE TABLES:

You may customize the entries made across the extreme left-hand row of the DSM, creating and saving several such tables so as to quickly shift between preferred formats.

One example, useful for organizing the DSM by Operational Operating Systems:

Field Name	Align	Width	Title
ID	Center	5	
Scheduled Start	Right	8	Start
Text1	Right	6	OOS

Another example, useful for organizing the DSM by Subordinate Commands:

Field Name	Align	Width	Title
ID	Center	5	
Resource	Right	10	Command
Text1	Right	6	OOS

FILTER: No changes necessary. This command allows you to create custom reports tailored to specific parameters. For instance, Figure 5 in Appendix B was created by setting a filter for only tasks in the MANUEVER OOS.

FORMAT:

SORT: Sorting allows you to change the order in which each task is displayed on the DSM. For a DSM formatted by Operational Operating Systems, sort by Text1, then ID. To format the DSM by Subordinate Commands, enter Resource, then ID.

By selecting the KEEP OUTLINE STRUCTURE box, the summary tasks (phases) will appear directly above the tasks of that phase. By disabling this box, all phases will appear across the top of the DSM.

GRIDLINES: Gridlines allow greater ease in reading across and down the DSM. Gridlines were selected for the following: MAJOR COLUMNS, SHEET ROWS, SHEET COLUMNS, TITLE VERTICAL, TITLE HORIZONTAL.

If a line is selected for the CURRENT DATE field, a vertical line will appear on the DSM at the current date of the timeline.

OUTLINE:

Select SUMMARY TASKS, NAME INDENTATION

TIMELINE:

Major Scale: MOS/'92 JAN/CENTER; select TICKLINES

Minor Scale: DAYS/1,2/CENTER; select TICKLINES

PALETTE:

This allows you to select the width, shading, patterning and shapes of various graphics on the DSM. It is useful to select different patterns between critical and non-critical tasks. Milestones are a diamond in a circle, and the summary bar has polygonal endshapes.

MACRO: No changes necessary.

OPTIONS:

PREFERENCES:

Default work units: change "hours" to "days."

BASE CALENDARS:

Change all weekend days from "nonworking" to "working." It is not necessary to change the hours to "24 hours" unless you intend on displaying that level of resolution in a campaign plan.

WINDOW: No changes necessary.

HELP: No changes necessary.

APPENDIX B: EXAMPLES OF DSM FORMATS

The purpose of this appendix is to present an example of a Dynamic Synchronization Matrix which has been customized in accordance with the specifications outlined in Appendix A. This example is based upon NATO Campaign Plan 94-2, the scenario presented during the '93-'94 Advanced Military Studies Program Lesson 3-20, "European Crisis Response Exercise."

This section is intended to highlight the capabilities and limitations of the DSM, and not to conduct a mission analysis and wargame. Therefore, this appendix will not present a detailed background of either the scenario or the week-long planning exercise. However, some information is presented for necessary context:

MISSION: On order, NATO forces deploy to Bosnia Theater of Operation (BTO); conduct peace enforcement operations to separate and disarm warring factions, restore law and order, and provide humanitarian assistance to displaced persons and refugees in order to end the Yugoslav Civil War and set the conditions for a political settlement.
Be prepared to prevent JNA and Croatian military units from entering Bosnia.
On order, conduct peacekeeping operations and assist Bosnian leaders in developing a national guard and territorial defense force.
On order, transfer control to a follow-on peacekeeping force and redeploy.

The NATO campaign plan specifies six phases: Preparation; Deployment; Peace Building; Peace Enforcement; Peacekeeping/Peacebuilding; and Redeployment. In order to accomplish this mission, AFSOUTH organized assigned and OPCON forces into a single combined task force, Combined Joint Task Force-Alpha (CJTF-A). CJTF-A has designated this mission "OPERATION OVERDRIVE." The command relationships of CJTF-A are displayed in Figure 3.
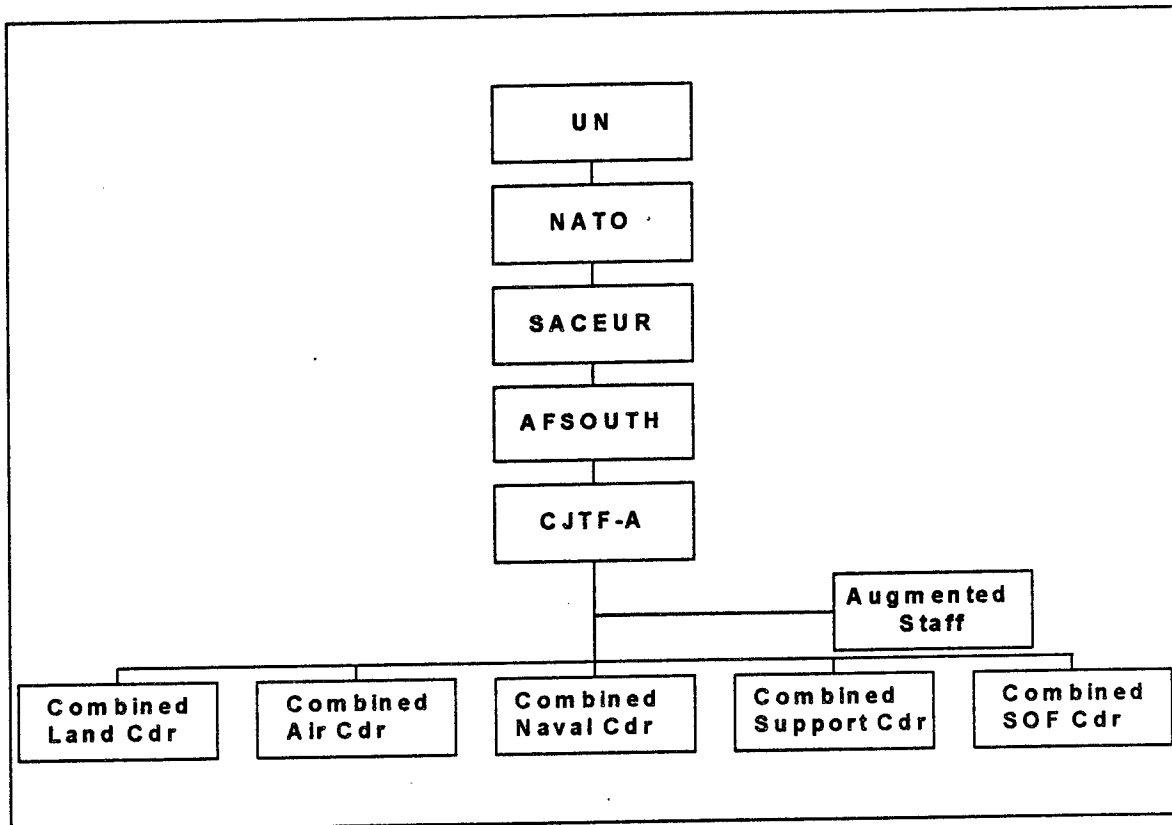
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Figure 3: CJTF-A Command Relationships

The remainder of this appendix will utilize the DSM developed during CJTF-A campaign staff mission analysis. In the follwing sections, various figures are used to portray specific aspects and options of the DSM. In the final section, Figure 9 (foldout) depicts a sample CJTF-A "Operation Overdrive" DSM is presented in its entirety. Readers are encouraged to critically review the following examples, noting both the unique capabilities of the DSM and areas which need improvement in future versions.

ID	Start	OOS	'94 May	'94 Jun	'94 Jul	'94 Aug	'94 Sep	
			1 8 15 22 29	5 12 19 26	3 10 17 24 31	7 14 21 28	4 11 18 25	2
16	94/7/2	C2			Sufficient Peace Enforcement forces in BTO — 15,14 ⊙ CJTF-A 0d			
17	94/6/3			14 ▼			Phase III: Peace Buil — 218d	
20	94/6/3	SUPT		14 Phase IV Log Buildup ═══ CSUPCOM 60d				
18	94/7/3	C2			Liaison Tms to NGO, UNPROFOR — 16,5 ■ CSOC 3d			
19	94/7/6	SUPT			18 Humanitarian Asst Op; — 180d			
21	94/7/11	SUPT			18,25FF ═══ Refugee Control O;			1£
22	94/8/9	C2				D-DAY 16FS+15d,19SS+35d,20 ⊙ CJTF-A 0d		
23	94/8/10					22 ▼	Phas	
24	94/8/10	FIRE				Establish Air Supremacy 11,16 ═ CJFACC 5d		
25	94/8/10	SUPT				22 ═══	Ref	

Figure 4: Legend Extract of DSM

Figure 4 depicts an extract of the DSM which serves as a legend. The row titles and other descriptives in the leftmost columns may be customized to meet user needs. In this example, the ID numbers in the leftmost column have no intrinsic meaning; they were assigned in chronological order during data entry and now simply provide a quick

reference. The start date for the task, and the primary Operational Operating System invoked by the task are listed in the next two columns.

Activities are depicted as bars occupying time, while effects (such as conditions, or endstates) are depicted as a diamond in a circle. Since effects, unlike activities, do not endure their own time, effects are annotated as having a task duration of zero days. The solid bars with triangular endpoints represent the phases of the operation.

The numbers listed beneath the task bars are the projected duration of the task, in days. Once a task is complete, the accuracy of the DSM can be improved by updating this projected duration figure with the actual duration figure (see Figure 7). Horizontal lines inside bars indicate that the task is non-critical (in PERT terminology), while hatched bars represent critical tasks. By definition, any increases in critical task duration will cause the entire operation to be delayed. The command headquarters (either CJTF-A or a subordinate command) responsible for the task is annotated to the right of the task.

To the left of each activity or effect are the predecessor tasks, and their relationship to that event or effect. For instance, Task 19 (Humanitarian Assistance Operations, Croatia/Slovenia) cannot commence until Task 18 (Liaison team to non-governmental agencies and UNPROFOR) is complete.

A more complex example is seen in Task 22 ("D-Day") which notes "16FS+15d, 19SS+35d, 20." This indicates that D-Day can not occur until 15 days after event 16 has been completed (FS indicates a "finish to start" relationship; SS indicates a "start to start" relationship), 35 days after event 19 has started, and event 20 has been completed. The second criteria corresponds to the commander's guidance that humanitarian assistance operations in Croatia (event 19) should be given an opportunity (4 to 6 weeks) to persuade the JNA units to seek a ceasefire before resorting to a peace enforcement operation.

			1994													1995						
ID	Start	OOS	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
7	94/2/18	MAN	Prep for deployment 2 ▭ CSUPCOM 30d																				
15	94/4/4	MAN	Forces Deployment, Buildup 12,13,7 ▬ CJFLCC 90d																				
26	94/8/10	MAN	Occupy zones separating factions 22 ▬ CJFLCC 30d																				
27	94/8/20	MAN	Disarm factions 26SS+10d ▬ CJFLCC 60d																				
28	94/9/19	MAN	Enforce Sanctions 24,32FF,30FF ▬ CJFNCC 120d																				
32	94/10/19	MAN	Enforce Peace 30 ▬ CJFLCC 90d																				
38	95/2/1	MAN	Redeploy force 36 ▬ CSUPCOM 90d																				

Figure 5: OOS Extract of DSM

Figure 5 depicts a DSM extract organized ("sorted") according to Operational Operating Systems (OOS). In this example, only Operational Movement and Maneuver (MAN) tasks are displayed.

ID	Start	Unit		1994					1995			
			4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
6	94/2/18	CSUPCOM		Logistics Prep 2 ▭ SUPT 30d								
7	94/2/18	CSUPCOM		Prep for deployment 2 ▭ MAN 30d								
13	94/3/30	CSUPCOM		Secure Lodgement 12 ▮ PROT 5d								
14	94/4/4	CSUPCOM		Phase III Logistics Buildup 13 ▭ SUPT 60d								
20	94/6/3	CSUPCOM			Phase IV Log Buildup 14 ▭ SUPT 60d							
35	94/10/19	CSUPCOM					Repair Infrastructure ▭ SUPT 60d					
39	95/2/1	CSUPCOM							Assist flow of UN into theatre 36FS-15d ▭ SUPT 60d			
38	95/2/1	CSUPCOM							Redeploy force 36 ▨ MAN 90d			

Figure 6: Subordinate Command Extract of DSM

Figure 6 depicts a DSM extract organized according to specified tasks assigned to a particular subordinate commander. In this example, all tasks assigned to the Combined Support Command are compiled.
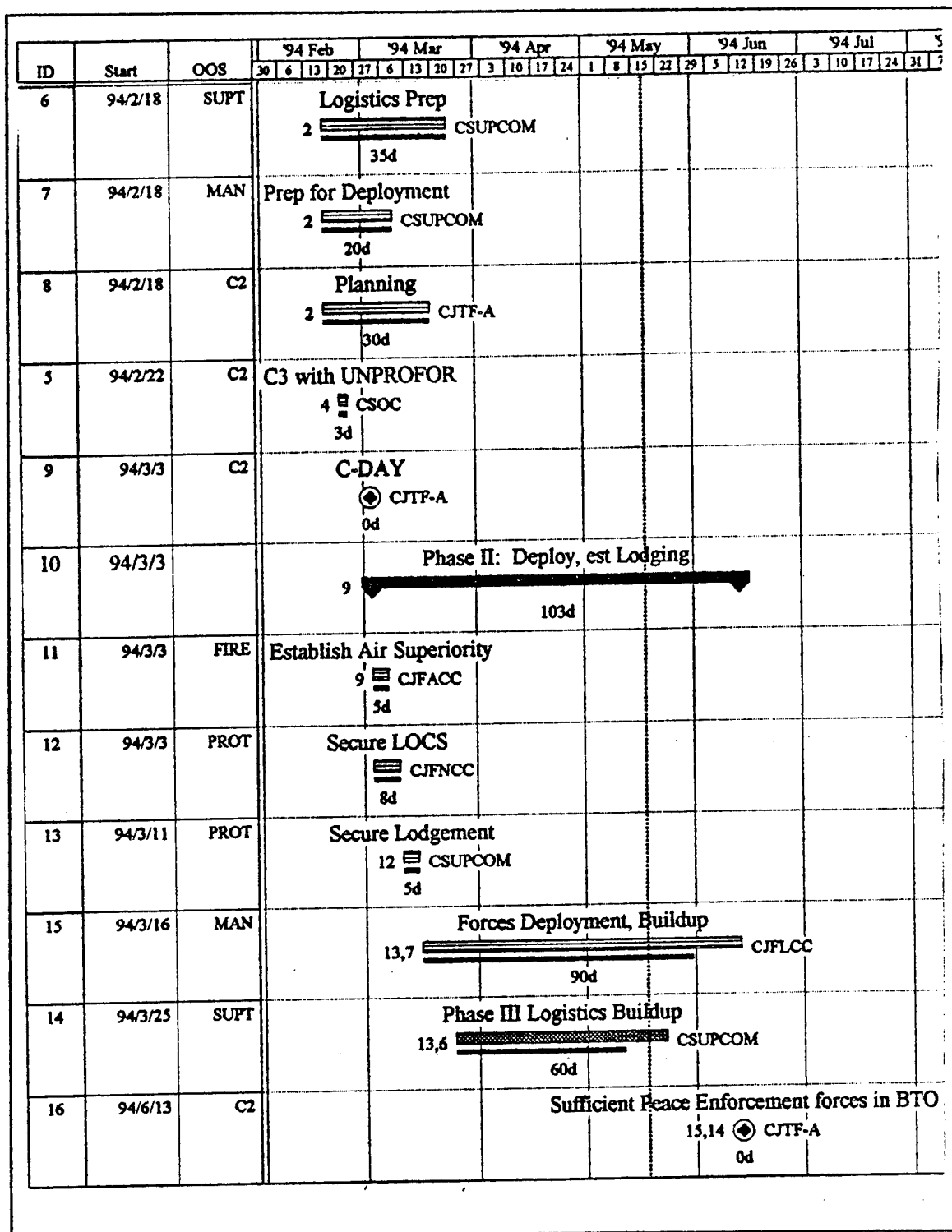
ID	Start	OOS	Task
6	94/2/18	SUPT	Logistics Prep — 2 ▭ CSUPCOM — 35d
7	94/2/18	MAN	Prep for Deployment — 2 ▭ CSUPCOM — 20d
8	94/2/18	C2	Planning — 2 ▭ CJTF-A — 30d
5	94/2/22	C2	C3 with UNPROFOR — 4 ▭ CSOC — 3d
9	94/3/3	C2	C-DAY — ◉ CJTF-A — 0d
10	94/3/3		Phase II: Deploy, est Lodging — 9 ◄═══► — 103d
11	94/3/3	FIRE	Establish Air Superiority — 9 ▭ CJFACC — 5d
12	94/3/3	PROT	Secure LOCS — ▭ CJFNCC — 8d
13	94/3/11	PROT	Secure Lodgement — 12 ▭ CSUPCOM — 5d
15	94/3/16	MAN	Forces Deployment, Buildup — 13,7 ▭ CJFLCC — 90d
14	94/3/25	SUPT	Phase III Logistics Buildup — 13,6 ▭ CSUPCOM — 60d
16	94/6/13	C2	Sufficient Peace Enforcement forces in BTO — 15,14 ◉ CJTF-A — 0d

Timeline header: '94 Feb | '94 Mar | '94 Apr | '94 May | '94 Jun | '94 Jul
(30 6 13 20 27 | 6 13 20 27 | 3 10 17 24 | 1 8 15 22 29 | 5 12 19 26 | 3 10 17 24 31)

Figure 7: Extract of Updated DSM

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Figure 7 depicts a DSM updated during execution to reflect differences between planned and actual events, and to provide a revised estimate for future planning.

This example uses a dashed vertical line to indicate the current date (18 May 1994). The actual amount of time need to complete the finished tasks has been entered -- hence, Task 6 (logistics prep) took longer than the projected 30 days, while Task 7 (deployment prep) was completed 10 days ahead of schedule. This update also indicates that C-Day was announced earlier than expected, causing Phase II to begin sooner.

The percentage of task completion is indicated by an underlining bar. While all tasks prior to this date are completed, the position of the bar indicates that current Task 15 is ahead of schedule, while current Task 14 is behind schedule. Since the shading inside the bars indicates that Task 15 is a critical task and Task 14 is not, completing Phase II may not be delayed by Task 14's delay. However, the sensitivity of the entire plan to unprojected changes in the duration of any event can be tested by changing the projected duration of the task in question to reflect a longer time estimate.

Figure 8 depicts a "branch" DSM extract. In this example, the commander has asked the staff to project the impact of a permanent ceasefire occurring without having to launch Phase IV (Peace Enforcement).
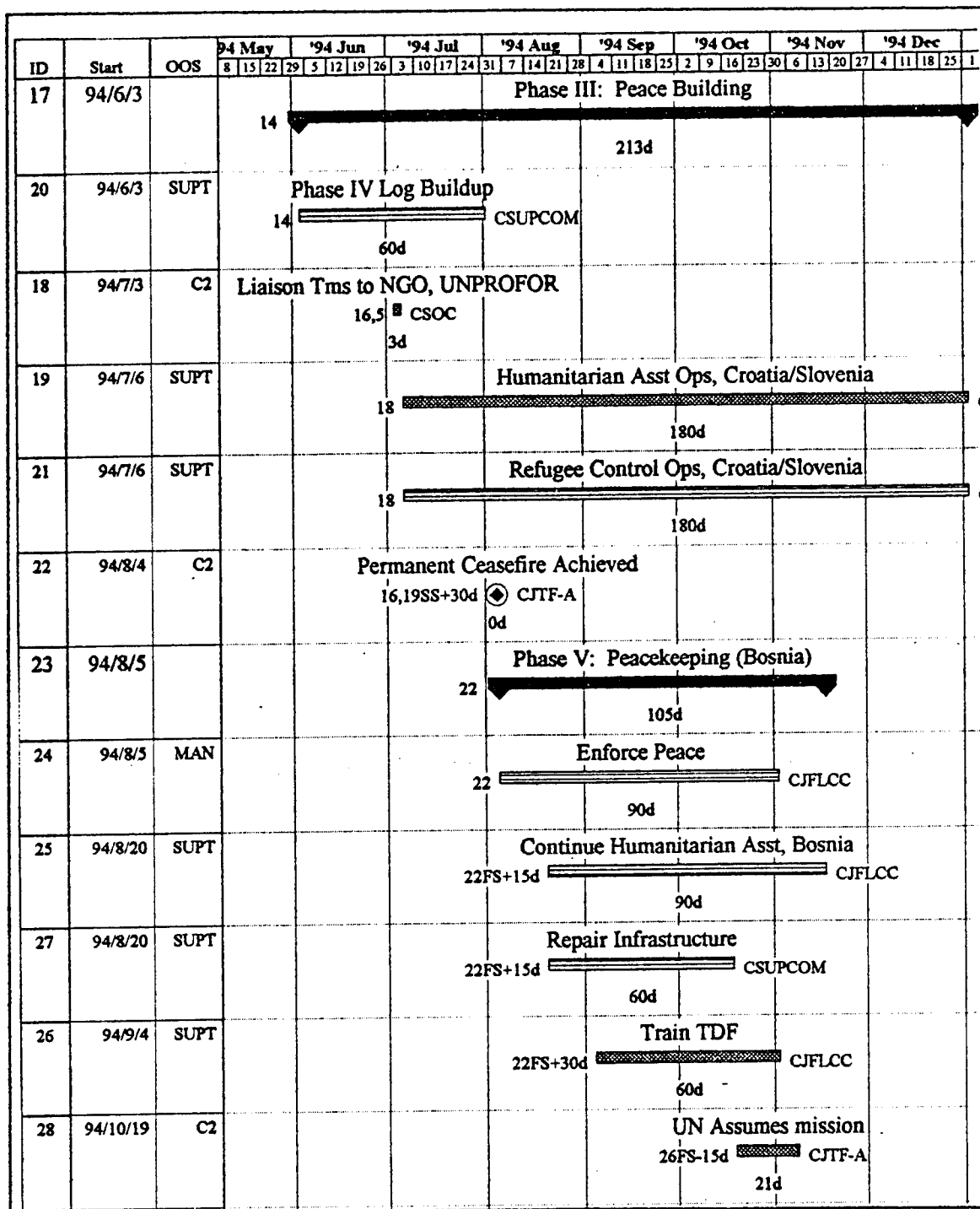
ID	Start	OOS	Timeline / Task

Figure 8: Extract of Branch DSM

Figure 9 (foldout) depicts a DSM for Operation OVERDRIVE in its entirety.

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